DOCTOR DEVICE OF CAST COATER DRUM

Patent Number: JP5214696
Publication date: 1993-08-24
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Requested Patent: JP5214696
Application Number: JP19920017893 19920203
Priority Number(s):
IPC Classification: D21G3/00 ; D21H19/36
EC Classification:
Equivalents:

Abstract

PURPOSE:To provide the subject device not requiring a pressing mechanism and not forming sliding marks on the surface of the drum by forming doctor blades applied to the surface of the mirror surface cast coater drum plated with chromium out of ultrahigh mol.wt. polyethylene, etc.
CONSTITUTION:In a doctor device to be applied to a chromium-plated mirror surface cast coater drum used for producing paper, the doctor blades 4 of the doctor device 5 are made of ultrahigh mol.wt. polyethylene or fiber-reinforced ultrahigh mol.wt. polyethylene. The doctor blades 4, 4 are dividedly disposed on the surface of the cast coater drum 2 so as to remove a coating solution 3 in a prescribed width from the more inner sides than parts contacting with both the ends of a minimum wide coated paper sheet 1 toward both the axial ends of the drum. An oscillation means 6 for reciprocatively moving the doctor blades 4 in the axial direction of the drum is disposed, thereby permitting to effectively remove the excessive coating solution without forming sliding marks on the surface of the cast coater drum 2 and further to coat raw paper sheets having various widths without stopping the operations.

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WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B29C 70/52, D21G 3/00, 3/02 — A1

(11) International Publication Number: WO 99/12726

(43) International Publication Date: 18 March 1999 (18.03.99)

(21) International Application Number: PCT/FI98/00690

(22) International Filing Date: 4 September 1998 (04.09.98)

(30) Priority Data:
973659 11 September 1997 (11.09.97) FI

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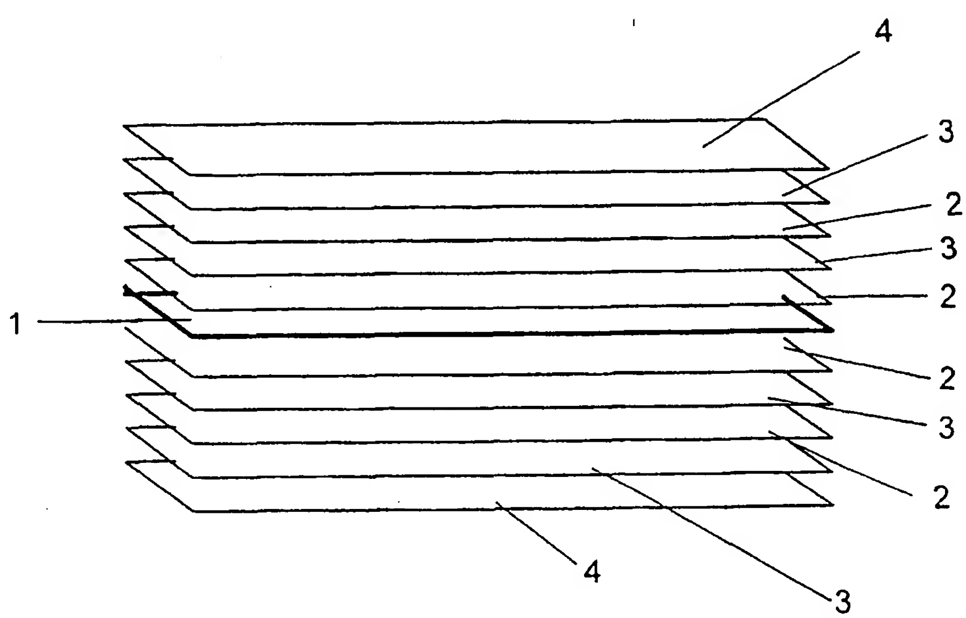
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
With amended claims.

(54) Title: CARING DOCTOR BLADE AND METHOD FOR MANUFACTURE OF SAME



(57) Abstract

The invention concerns a caring doctor blade for a paper/board machine, which blade comprises layers of fibreglass and carbon fibre and a caring layer as a rigid laminated structure, which caring layer comprises carbon fibres and grinding particles in direct vicinity of the carbon fibres. The orientation of the fibreglass layers is parallel to the longitudinal axis of the blade, and at least in some of the layers that contain carbon fibre the orientation of the carbon fibres is substantially diverging from the direction of the longitudinal axis of the blade. The invention also concerns a method for manufacture of a doctor blade for a paper/board machine by means of a pultrusion method.

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Caring doctor blade and method for manufacture of same

The invention concerns a caring doctor blade for a paper/board machine and a method for manufacture of same.

The faces of the rolls in a paper/board machine tend to be coated with impurities coming from the process and with material of the doctor blade. For removal of these materials from the roll faces, doctor blades are employed.

Typical commercial blades are described, for example, in the US Patent 4,549,933 and in the SU Patent 1,694,755.

In the *US Patent No. 4,549,933*, a doctor blade for a paper machine is described, which consists of a number of alternating layers of fibre and carbon fibre so that the fibre layer may be composed of cotton, paper, fibreglass, or equivalent. Such a blade detaches contaminations, but, on the other, foreign material is separated from the blade onto the roll face.

In the *SU Patent No. 1,694,755*, a doctor blade meant for cleaning of rolls and cylinders is described for use in pulp and paper industry. This blade is made of a composite material, in which, over the thickness of the blade, layers of fibre and fabric filler perpendicular to the blade edge alternate. This doctor blade is used for cleaning of the roll faces. Besides the fabric filler, for the doctor, carbon band, boron fibre or tungsten is used as fibre, and the alignment of the fibres is perpendicular to the direction of the blade.

None of said blade constructions contains particles of abrasive material.

In the *US Patent No. 5,174,862*, a polishing doctor blade is described for polishing the metal face of a calender roll. The machining face placed at the head of the blade comprises grinding particles mixed with an epoxy matrix, such as carbides or diamonds. The blade does not operate as a doctoring blade. It is meant exclusively for calender rolls, at which its function is exclusively to grind/polish the face of the calender roll.

In the *FI Patent Application No. 941620*, a method and an equipment are described for conditioning of the coating on a roll in a paper machine. What is concerned is not a doctor blade, but in the method of FI-941620 the roll is ground by means of a separate grinding rib to be attached to a doctor blade so as to correct the roughness of the roll face to make the face either smoother or rougher, as required. In such a case, the conditioning of the roll face takes place during a standstill on-site, i.e without removing the roll from the machine, but the device does not operate during production or at a production speed.

Coating with a foreign material often results in alteration of the surface properties of a roll, which again deteriorates the runnability and the properties of paper. If the coating is intensive, the roll face may become excessively smooth, which results, on a centre roll in the press, for example, in more difficult separation of the paper web, passing of the web through the doctor, and, thus, in increased susceptibility of web breaks. Besides the coating effect, a second negative aspect in the case of metal blades is scratching of the roll face or, in some cases, penetration of the blade into the roll coating if a polymer-based coating is concerned. Also, excessive roughening of a roll face, which occurs with prolonged operation of metal blades, causes deterioration of the operating capacity of the roll face.

Smoothing or roughening of a roll face is typical of a roll that contains ceramic coating material, but it also occurs with other coatings. The coating effect of the blades of reinforced plastic commonly employed with ceramic roll coatings mainly results from adhesion of particles detached from the blade by abrasion or from melting of the matrix plastic onto the roll face. On the other hand, materials coming

from the process also adhere to the roll face, which materials cannot be removed by the doctor from the recesses in the roughness of the face, as the doctor cannot remove the layer of impurities deposited on these materials "anchored" on the bottom of said recesses either, because the adhesion is too strong.

Even the best conventional doctor blade cannot remove all the undesirable material already adhering to the roll face from the roll face, but the blade often brings more material to the roll face. This is why there has been a need to develop a doctor blade which removes undesirable contaminations or other material coated onto the roll face from the roll face to a greater extent than the blade itself brings onto the roll face and which doctor blade keeps the roll face in its original condition or restores it to its original condition.

The object of the present invention is a caring doctor blade for a paper/board machine, which blade removes undesirable coated material from the roll face and, at the same time, services the roll face, and a method for manufacture of such a blade.

The doctor blade in accordance with the present invention and the method for manufacture of same are characterized in what is stated in the patent claims.

By means of the solution that will be described in the following, the problems involved in the prior-art solutions are avoided and the objectives that have been set are achieved. In the solution in accordance with the invention, in the caring doctor blade, an abrasive blade and an almost optimal, carbon-fibre reinforced composite blade of reinforced plastic are combined. The caring doctor blade is not supposed to be exclusively abrasive, as the conventional abrasive blades are, but it is also supposed to have excellent doctoring and cleaning properties. Thus, in the caring doctor blade, the functions of two different blade types are combined. It is an essential feature of the properties of the caring blade that the structure of the blade is of a correct sort. The blade is a carbon-fibre/fibreglass composite, which contains a grinding material in a layer that contains fibreglass or carbon fibre. The content of

carbon fibre in the composite is high, the content of the matrix material is low, and the fibre orientation is optimal.

The solution in accordance with the invention will be described in detail in Fig. 1, in which a preferred solution in accordance with the present invention is illustrated by way of example.

The doctor blade as shown in Fig. 1 comprises a rigid laminate structure consisting of fibreglass and carbon fibre layers 2 and 3 and of at least one caring layer 1. The caring layer 1 is surrounded by fibreglass layers and possibly by carbon fibre layers. Besides carbon fibre, the carbon fibre layers 3 may also contain fibreglass. In the fibreglass layers 2, the fibreglass layers are orientated parallel to the longitudinal axis of the blade, and in at least some of the layers that contain carbon fibre, the carbon fibres are orientated substantially obliquely to the longitudinal axis of the doctor blade, preferably transversely to the blade direction. The topmost layers 4 are preferably mats with fibreglass surface.

The caring layer 1 comprises carbon fibres and grinding particles in direct vicinity of the carbon fibres, possibly additionally also glass fibres. As the grinding particles, it is possible to employ silicon carbide particles, diamond, boron nitride, aluminum oxide, or equivalent, the preferable one being silicon carbide. In the layer, there may be grinding particles across the entire width of the blade, but they can also be placed differently, for example at the edge of the blade that enters into contact with the roll. The grinding particles have been introduced into connection with the carbon fibres, for example, by impregnating into a carbon fibre fabric by means of a matrix material, which can be thermosetting or thermoplastic resin, and its basic matrix can be fluorinated.

In order that a suitable caring grinding effect could be obtained, the nature of the grinding agent (silicon carbide, diamonds, boron nitride, aluminium oxide, or equivalent; preferably silicon carbide) and the particle size (30 ... 250 μm; preferably 45 ... 125 μm) and the amount of particles on the wear face placed against the

roll are chosen appropriately. The amount can be changed by adjusting the density of particles in the layer and/or by increasing the number of the layers that contain particles, for example 1...5 layers. The duration of the grinding effect can be regulated by fitting the particles on a certain distance within the wear margin only. In this way the grinding effect can be standardized in the cross direction of the whole roll even if the rate of wear of the blade in different areas were different. When expensive grinding materials are used, it is preferable to place the particles in the area of the wear margin only.

The thickness of the doctor blade is preferably about 1.3 ... 2.8 mm, while the thicknesses of the individual layers are of an order of about 0.1 ... 0.3 mm, the caring layer about 0.1 ... 0.4 mm. The doctor blade is manufactured preferably by means of a pultrusion method. In such a case, the grinding material is brought into connection with the carbon fibre fabric, for example impregnated into said fabric, before the pultrusion stage. Also, conventional methods known from the manufacture of sandwich constructions can be employed.

The higher the content of carbon fibre in the doctor blade of reinforced plastic is in relation to fibreglass and in particular in relation to matrix plastic, the slower is the covering of the roll face with plastic or the coating of the roll face at least in respect of the material separated from the blade. The case is also affected by how optimal the fibre orientation in the blade is and how good the resistance to heat of the matrix is. Favourable matrix materials are thermosetting or thermoplastic resins that endure a temperature higher than 200°C. Longitudinal glass fibres and possible carbon fibres give the structure the necessary robustness and rigidity in the longitudinal direction.

From the point of view of the operability of the blade, it is important that the grinding, hard particles, for example silicon carbide, are surrounded by carbon fibre. The function of the carbon fibre is to conduct the arising friction heat away from the grinding particles so that the matrix material around the particles of grinding material does not burn or melt, with resulting removal of the grinding particles. A

substantially cross-direction orientation of the carbon fibres provides good conductivity of heat away from the tip of the blade, i.e. away from the matrix which constitutes the fixing agent for the grinding material and from the particles of grinding material, in which case the melting of the matrix is reduced. Further, the rigidity of the blade in the cross direction is high, which improves the doctoring result. The blade is, however, resilient in the longitudinal direction of the blade, in which case the blade follows the roll face and complies with the roll face well over the entire length of the blade. Such a doctor blade operates excellently as a shearing blade, in addition to the abrading effect; a conventional abrasive blade cannot cut off the impurities. Thus, by means of a single blade, a multiple effect is obtained, which provides evident advantages also in a case in which, on the rolls, both a grinding blade and a shearing blade can be used separately in a doctor.

AMENDED CLAIMS

[received by the International Bureau on 16 February 1999 (16.02.99); original claims 1-6 replaced by amended claims 1-6 (2 pages)]

1. A doctor blade for a paper/board machine, which blade comprises a number of fibrous layers as a laminated structure, **characterized** in that the structure comprises at least one layer made of carbon fibre or substantially containing carbon fibre, which layer contains grinding particles in direct vicinity of the carbon fibres and in which layer the orientation of the carbon fibres is substantially diverging from the direction of the longitudinal axis of the blade, preferably in the cross direction of the blade.

2. A doctor blade as claimed in claim 1, **characterized** in that the grinding material is silicon carbide, diamond, boron nitride, aluminum oxide, or equivalent, and its particle size is 30 ... 250 μm, preferably 45 ... 125 μm.

3. A doctor blade as claimed in claim 1 or 2, **characterized** in that the grinding particles are impregnated into a fabric of carbon fibre by means of a matrix material, which can be a thermosetting or thermoplastic resin and possibly fluorinated.

4. A doctor blade as claimed in claim 1, **characterized** in that the grinding particles are placed at the edge that enters into contact with the roll, preferably in the area of the wear margin of the blade only or in a part of said area only.

5. A doctor blade as claimed in claim 1, **characterized** in that the layer of carbon fibre that contains grinding particles has been surrounded with layers of fibreglass and carbon fibre, in which layers the directions of orientation of the glass fibres are substantially parallel to the longitudinal axis of the blade, and in which layers the directions of orientation of the carbon fibres are substantially diverging from the direction of the longitudinal axis of the blade.

6. A method for manufacture of a doctor blade for a paper/board machine, **characterized** in that the blade is manufactured by means of a pultrusion method, in which

the grinding particles are affixed, for example, by impregnating by means of a matrix material, to the fibre fabric before the pultrusion stage.

Claims

1. A doctor blade for a paper/board machine, which blade comprises a number of fibrous layers as a laminated structure, **characterized** in that the structure comprises at least one layer made of carbon fibre or substantially containing carbon fibre, which layer contains grinding particles in direct vicinity of the carbon fibres and in which layer the orientation of the carbon fibres is substantially diverging from the direction of the longitudinal axis of the blade, preferably in the cross direction of the blade.

2. A doctor blade as claimed in claim 1, **characterized** in that the grinding material is silicon carbide, diamond, boron nitride, aluminum oxide, or equivalent, and its particle size is 30 ... 250 μm, preferably 45 ... 125 μm.

3. A doctor blade as claimed in claim 1 or 2, **characterized** in that the grinding particles are impregnated into a fabric of carbon fibre by means of a matrix material, which can be a thermosetting or thermoplastic resin and possibly fluorinated.

4. A doctor blade as claimed in claim 1, **characterized** in that the grinding particles are placed at the edge that enters into contact with the roll, preferably in the area of the wear margin of the blade only or in a part of said area only.

5. A doctor blade as claimed in claim 1, **characterized** in that the layer of carbon fibre that contains grinding particles has been surrounded with layers of fibreglass and carbon fibre, in which layers the directions of orientation of the glass fibres are substantially parallel to the longitudinal axis of the blade, and in which layers the directions of orientation of the carbon fibres are substantially diverging from the direction of the longitudinal axis of the blade.

6. A method for manufacture of a doctor blade for a paper/board machine, **characterized** in that the blade is manufactured by means of a pultrusion method, in which

the grinding particles are affixed, for example, by impregnating by means of a matrix material, to the fibre fabric before the pultrusion stage.

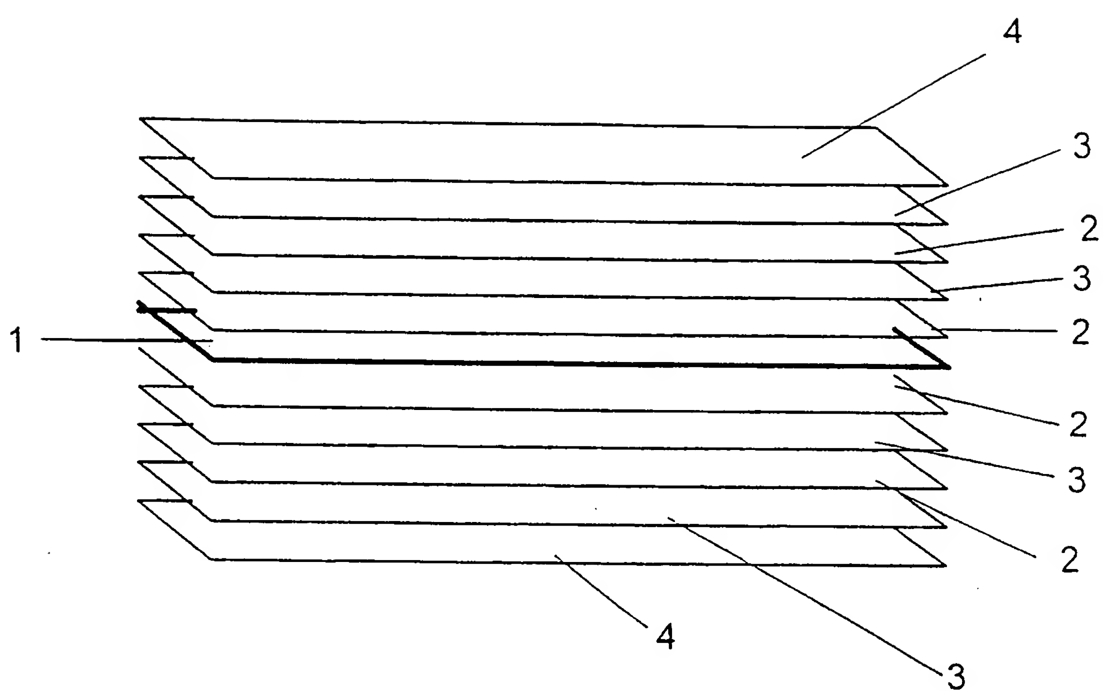

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00690

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B29C 70/52, D21G 3/00, D21G 3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B24B, B24D, G03G, D21G, B29C, B29B, C08J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

FULLTEXT, EDOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4549933 A (MICHAEL JUDD ET AL), 29 October 1985 (29.10.85), figure 5, abstract, claims --	1-5
Y	Patent Abstracts of Japan, abstract of JP 54-149787 A (ICHIKAWA KEORI KK), 24 November 1979 (24.11.79) --	1-5
A	US 5460565 A (GEORGE C. PERNECZKY), 24 October 1995 (24.10.95), column 3, line 20 - line 25, abstract --	1-5
A	US 5623718 A (PETER W.BRACKEN ET AL), 22 April 1997 (22.04.97) --	1-5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 January 1999	29 -01- 1999
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INTERNATIONAL SEARCH REPORT
Information on patent family members

21/12/98

International application No.
PCT/FI 98/00690

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4549933 A	29/10/85	NONE	
US 5460565 A	24/10/95	AU 4652893 A	14/02/94
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